

**IN THE CLAIMS**

This is a complete and current listing of the claims, marked with status identifiers in parentheses. The following listing of claims will replace all prior versions and listings of claims in the application.

1-16 (Cancelled)

17. (Previously Presented) A method for establishing cryptographic communications, comprising the steps of:

encoding a plaintext message word  $M$  to a ciphertext word  $C$ , wherein  $M$  corresponds to a number representative of a message and wherein

$$0 \leq M \leq n-1,$$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers,  $C$  is a number representative of an encoded form of message word  $M$ , and wherein said encoding step comprises transforming said message word  $M$  to said ciphertext word  $C$ , whereby

$$C \equiv M^e \pmod{n},$$

and wherein  $e$  is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ; and

decoding said ciphertext word  $C$  to a receive message word  $M'$ , said decoding step being performed using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \pmod{((p_1-1)(p_2-1) \dots (p_k-1))},$$

said decoding step including the further steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{d_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{d_2} \pmod{p_2},$$

$$\vdots$$

$$M_k' \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv C \pmod{p_k},$$

$$\begin{aligned}d_1 &\equiv d(\text{mod}(p_1 - 1)), \\d_2 &\equiv d(\text{mod}(p_2 - 1)), \text{ and} \\&\vdots \\d_k &\equiv d(\text{mod}(p_k - 1)),\end{aligned}$$

solving said sub-tasks to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

18. (Original) A method as recited in claim 17 wherein said step of combining said results of said sub-tasks includes a step of performing a recursive combining process to produce said receive message word  $M'$ .

19. (Original) A method as recited in claim 18 wherein said recursive combining process is performed in accordance with

$$\begin{aligned}Y_i &\equiv Y_{i-1} + [(M_i' - Y_{i-1})(w_i^{-1} \text{ mod } p_i) \text{ mod } p_i] \bullet w_i \text{ mod } n, \\&\text{wherein } 2 \leq i \leq k, \text{ and} \\M' &= Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.\end{aligned}$$

20. (Original) A method as recited in claim 17 wherein said step of combining said results of said sub-tasks includes a step of performing a summation process to produce said receive message word  $M'$ .

21. (Original) A method as recited in claim 20 wherein said summation process is performed in accordance with

$$\begin{aligned}M' &\equiv \sum_{i=1}^k M_i' (w_i^{-1} \text{ mod } p_i) w_i \text{ mod } n, \\&\text{where} \\w_i &= \prod_{j \neq i} p_j.\end{aligned}$$

22. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

encoding means coupled to said communication medium and adapted for transforming a transmit message word  $M$  to a ciphertext word  $C$  and for transmitting said ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$0 \leq M \leq n-1$ , wherein  $n$  is a composite number of the form,

$$n = p_1 \cdot p_2 \cdot \dots \cdot p_k$$

wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said ciphertext word  $C$  corresponds to a number representative of an enciphered form of said message word  $M$  and corresponds to

$$C \equiv M^e \pmod{n},$$

wherein  $e$  is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ; and

decoding means communicatively coupled with said communication medium for receiving said ciphertext word  $C$  via said medium, said decoding means being operative to perform a decryption process for transforming said ciphertext word  $C$  to a receive message word  $M'$ , wherein  $M'$  corresponds to a number representative of a deciphered form of  $C$ , said decryption process using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \pmod{(p_1-1)(p_2-1)\dots(p_k-1)},$$

said decryption process including the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{d_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{d_2} \pmod{p_2},$$

$\vdots$

$$M_k' \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$\vdots$

$$C_k \equiv C \pmod{p_k},$$

$$\begin{aligned}d_1 &\equiv d(\text{mod}(p_1 - 1)), \\d_2 &\equiv d(\text{mod}(p_2 - 1)), \text{ and} \\&\vdots \\d_k &\equiv d(\text{mod}(p_k - 1)),\end{aligned}$$

solving said sub-tasks to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

23. (Original) A cryptographic communications system as recited in claim 22 wherein said decoding means is operative to combine said results of said sub-tasks by performing a recursive combining process to produce said receive message word  $M'$ .

24. (Original) A cryptographic communications system as recited in claim 23 wherein said decoding means is operative to perform said recursive combining process in accordance with

$$Y_i \equiv Y_{i-1} + [(M_i' - Y_{i-1})(w_i^{-1} \text{ mod } p_i) \text{ mod } p_i] \bullet w_i \text{ mod } n,$$

wherein  $2 \leq i \leq k$ , and

$$M' = Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.$$

25. (Original) A cryptographic communications system as recited in claim 22 wherein said decoding means is operative combine said results of said sub-tasks by performing a summation process to produce said receive message word  $M'$ .

26. (Original) A cryptographic communications system as recited in claim 25 wherein said decoding means is operative to perform said summation process accordance with

$$M' \equiv \sum_{i=1}^k M_i' (w_i^{-1} \text{ mod } p_i) w_i \text{ mod } n,$$

where

$$w_i = \prod_{j \neq i} p_j .$$

27. (Previously Presented) A method for establishing cryptographic communications, comprising the step of:

encoding a plaintext message word  $M$  to a ciphertext word  $C$ , wherein  $M$  corresponds to a number representative of a message, and

$$0 \leq M \leq n-1$$

$n$  being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein the ciphertext word  $C$  is a number representative of an encoded form of message word  $M$ , wherein said step of encoding includes the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$C_1 \equiv M_1^{e_1} \pmod{p_1},$$

$$C_2 \equiv M_2^{e_2} \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv M_k^{e_k} \pmod{p_k},$$

wherein

$$M_1 \equiv M \pmod{p_1},$$

$$M_2 \equiv M \pmod{p_2},$$

$$\vdots$$

$$M_k \equiv M \pmod{p_k},$$

$$e_1 \equiv e \pmod{(p_1-1)},$$

$$e_2 \equiv e \pmod{(p_2-1)}, \text{ and}$$

$$\vdots$$

$$e_k \equiv e \pmod{(p_k-1)},$$

wherein  $e$  is a number relatively prime to  $(p_1-1)$ ,  $(p_2-1)$ , ..., and  $(p_k-1)$ , solving said sub-tasks to determine results  $C_1, C_2, \dots, C_k$ , and

combining said results of said sub-tasks to produce said ciphertext word  $C$ .

28. (Original) A method as recited in claim 27 wherein said step of combining said results of said subtasks includes a step of performing a recursive combining process to produce said ciphertext word C.

29. (Original) A method as recited in claim 28 wherein said recursive combining process is performed in accordance with

$$Y_i \equiv Y_{i-1} + [(C_i - Y_{i-1})(w_i^{-1} \bmod p_i) \bmod p_i] \bullet w_i \bmod n,$$

wherein  $2 \leq i \leq k$ , and

$$C = Y_k, Y_1 = C_1, \text{ and } w_i = \prod_{j < i} p_j.$$

30. (Original) A method as recited in claim 27 wherein said step of combining said results of said sub-tasks includes a step of performing a summation process to produce said ciphertext word C.

31. (Original) A method as recited in claim 30 wherein said summation process is performed in accordance with

$$C \equiv \sum_{i=1}^k C_i (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

32. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

encoding means coupled to said communication medium and operative to transform a transmit message word M to a ciphertext word C, and to transmit said ciphertext word C on said medium, wherein M corresponds to a number representative of a message, and

$$0 \leq M \leq n-1,$$

n being a composite number formed from the product of  $p_1 \bullet p_2 \bullet \dots \bullet p_k$  wherein k is an integer greater than 2 and  $p_1, p_2, \dots, p_k$ , are distinct random prime numbers, and wherein the

ciphertext word C is a number representative of an encoded form of message word M, said encoding means being operative to transform said transmit message word M to said ciphertext word C by performing an encoding process comprising the steps of

defining a plurality of k sub-tasks in accordance with

$$\begin{aligned} C_1 &\equiv M_1^{e_1} \pmod{p_1}, \\ C_2 &\equiv M_2^{e_2} \pmod{p_2}, \\ &\vdots \\ C_k &\equiv M_k^{e_k} \pmod{p_k}, \end{aligned}$$

wherein

$$\begin{aligned} M_1 &\equiv M \pmod{p_1}, \\ M_2 &\equiv M \pmod{p_2}, \\ &\vdots \\ M_k &\equiv M \pmod{p_k}, \\ e_1 &\equiv e \pmod{(p_1 - 1)}, \\ e_2 &\equiv e \pmod{(p_2 - 1)}, \text{ and} \\ &\vdots \\ e_k &\equiv e \pmod{(p_k - 1)}, \end{aligned}$$

wherein e is a number relatively prime to (p<sub>1</sub>-1), (p<sub>2</sub>-1), ..., and (p<sub>k</sub>-1), solving said sub-tasks to determine results C<sub>1</sub>, C<sub>2</sub>, ... C<sub>k</sub>, and

combining said results of said sub-tasks to produce said ciphertext word C.

33. (Original) A cryptographic communications system as recited in claim 32 wherein said encoding means is operative to combine said results of said sub-tasks by performing a recursive combining process to produce said ciphertext word C.

34. (Original) A cryptographic communications system as recited in claim 33 wherein said encoding means is operative to perform said recursive combining process in accordance with

$$Y_i \equiv Y_{i-1} + \left[ (C_i - Y_{i-1})(w_i^{-1} \pmod{p_i}) \pmod{p_i} \right] \bullet w_i \pmod{n},$$

wherein  $2 \leq i \leq k$ , and

$$C = Y_k, Y_1 = C_1, \text{ and } w_i = \prod_{j < i} p_j.$$

35. (Original) A cryptographic communications system as recited in claim 32 wherein said encoding means is operative to combine said results of said sub-tasks by performing a summation process to produce said message word C.

36. (Original) A cryptographic communications system as recited in claim 35 wherein said encoding means is operative to perform said summation process in accordance with

$$C \equiv \sum_{i=1}^k C_i (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

37. (Previously Presented) A method for establishing cryptographic communications, comprising the steps of:

decoding a ciphertext word C to a message word M, wherein M corresponds to a number representative of a message and wherein

$$0 \leq M \leq n-1$$

wherein n is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , k is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, C is a number representative of an encoded form of message word M that is encoded by transforming said message word M to said ciphertext word C whereby

$$C \equiv M^e \pmod{n},$$

and wherein e is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ;

said decoding step being performed using a decryption exponent d that is defined by

$$d \equiv e^{-1} \bmod ((p_1-1)(p_2-1)\dots(p_k-1)),$$

wherein said step of decoding includes the steps of

defining a plurality of k sub-tasks in accordance with

$$M_1 \equiv C_1^{d_1} \pmod{p_1},$$



$$M_2 \equiv C_2^{d_2} \pmod{p_2},$$

$\vdots$

$$M_k \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$\vdots$

$$C_k \equiv C \pmod{p_k},$$

$$d_1 \equiv d \pmod{(p_1 - 1)},$$

$$d_2 \equiv d \pmod{(p_2 - 1)}, \text{ and}$$

$\vdots$

$$d_k \equiv d \pmod{(p_k - 1)},$$

solving said sub-tasks to determine results  $M_1, M_2, \dots, M_k$ , and  
combining said results of said sub-tasks to produce said message word  $M$ .

38. (Original) A method as recited in claim 37 wherein said step of combining said results of said sub-tasks includes a step of performing a recursive combining process to produce said message word  $M$ .

39. (Original) A method as recited in claim 38 wherein said recursive combining process is performed in accordance with

$$Y_i \equiv Y_{i-1} + \left[ (M_i - Y_{i-1})(w_i^{-1} \pmod{p_i}) \pmod{p_i} \right] \bullet w_i \pmod{n},$$

wherein  $2 \leq i \leq k$ , and

$$M' = Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.$$

40. (Original) A method as recited in claim 37 wherein said step of combining said results of said sub-tasks includes a step of performing a summation process to produce said message word  $M$ .

41. (Original) A method as recited in claim 40 wherein said summation process is performed in accordance with

$$M \equiv \sum_{i=1}^k M_i (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

42. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

decoding means communicatively coupled with said communication medium for receiving a ciphertext word C via said medium, and being operative to transform said ciphertext word C to a receive message word M', wherein a message M corresponds to a number representative of a message and wherein,

$$0 \leq M \leq n-1$$

wherein n is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , k is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said ciphertext word C is a number representative of an encoded form of said message word M that is encoded by transforming M to said ciphertext word C whereby,

$$C \equiv M^e \pmod{n},$$

and wherein e is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ;

said decoding means being operative to perform a decryption process using a decryption exponent d that is defined by

$$d \equiv e^{-1} \bmod ((p_1-1)(p_2-1)\dots(p_k-1)),$$

said decryption process including the steps of

defining a plurality of k sub-tasks in accordance with,

$$M_1' \equiv C_1^{d_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{d_2} \pmod{p_2},$$

$\vdots$

$$M_k' \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C(\text{mod } p_1),$$

$$C_2 \equiv C(\text{mod } p_2),$$

$\vdots$

$$C_k \equiv C(\text{mod } p_k),$$

$$d_1 \equiv d(\text{mod}(p_1 - 1)),$$

$$d_2 \equiv d(\text{mod}(p_2 - 1)), \text{ and}$$

$\vdots$

$$d_k \equiv d(\text{mod}(p_k - 1)),$$

solving said sub-tasks to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

43. (Original) A cryptographic communications system as recited in claim 42 wherein said decoding means is operative to combine said results of said sub-tasks by performing a recursive combining process to produce said receive message word  $M'$ .

44. (Original) A cryptographic communications system as recited in claim 41 wherein said decoding means is operative to perform said recursive combining process in accordance with

$$Y_i \equiv Y_{i-1} + \left[ (M_i' - Y_{i-1})(w_i^{-1} \text{mod } p_i) \text{mod } p_i \right] \bullet w_i \text{mod } n,$$

wherein  $2 \leq i \leq k$ , and

$$M = Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.$$

45. (Original) A cryptographic communications system as recited in claim 42 wherein said decoding means is operative to combine said results of said sub-tasks by performing a summation process to produce said receive message word  $M'$ .

46. (Original) A cryptographic communications system as recited in claim 45 wherein said decoding

means is operative to perform said summation process in accordance with

$$M' \equiv \sum_{i=1}^k M_i' (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

47. (Previously Presented) A method for generating a digital signature, comprising the step of:

signing a plaintext message word  $M$  to create a signed ciphertext word  $C$ , wherein  $M$  corresponds to a number representative of a message, and

$$0 \leq M \leq n-1,$$

$n$  being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein the signed ciphertext word  $C$  is a number representative of a signed form of message word  $M$ , wherein

$$C \equiv M^d \pmod{n}, \text{ and}$$

wherein said step of signing includes the steps of defining a plurality of  $k$  sub-tasks in accordance with

$$C_1 \equiv M_1^{d_1} \pmod{p_1},$$

$$C_2 \equiv M_2^{d_2} \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv M_k^{d_k} \pmod{p_k},$$

wherein

$$M_1 \equiv M \pmod{p_1},$$

$$M_2 \equiv M \pmod{p_2},$$

$$\vdots$$

$$M_k \equiv M \pmod{p_k},$$

$$d_1 \equiv d \pmod{(p_1 - 1)},$$

$$d_2 \equiv d \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$d_k \equiv d(\text{mod}(p_k - 1)),$$

where d is defined by

$$d \equiv e^{-1} \text{mod}((p_1 - 1) \bullet (p_2 - 1) \bullet \dots \bullet (p_k - 1)), \text{ and}$$

e is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ , solving said sub-tasks to determine results  $C_1, C_2, \dots, C_k$ , and

combining said results of said sub-tasks to produce said ciphertext word C.

48. (Original) A method as recited in claim 47 wherein said step of combining said results of said sub-tasks includes a step of performing a recursive combining process to produce said ciphertext word C.

49. (Original) A method as recited in claim 48 wherein said recursive combining process is performed in accordance with

$$Y_i \equiv Y_{i-1} + [(C_i - Y_{i-1})(w_i^{-1} \text{mod } p_i) \text{mod } p_i] \bullet w_i \text{mod } n,$$

wherein  $2 \leq i \leq k$ , and

$$C = Y_k, Y_1 = C_1, \text{ and } w_i = \prod_{j < i} p_j.$$

50. (Original) A method as recited in claim 47 wherein said step of combining said results of said sub-tasks includes a step of performing a summation process to produce said signed ciphertext word C.

51. (Original) A method as recited in claim 50 wherein said summation process is performed in accordance with

$$C \equiv \sum_{i=1}^k C_i (w_i^{-1} \text{mod } p_i) w_i \text{mod } n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

52. (Previously Presented) A digital signature generation system, comprising:  
a communication medium;

digital signature generating means coupled to said communication medium and operative to transform a transmit message word  $M$  to a signed ciphertext word  $C$ , and to transmit said signed ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$$0 \leq M \leq n-1,$$

$n$  being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$ , are distinct random prime numbers, and wherein the signed ciphertext word  $C$  is a number representative of a signed form of said message word  $M$ , wherein

$$C \equiv M^d \pmod{n},$$

said digital signature generating means being operative to transform said transmit message word  $M$  to said signed ciphertext word  $C$  by performing a digital signature generating process comprising the steps of,

defining a plurality of  $k$  sub-tasks in accordance with,

$$C_1 \equiv M_1^{d_1} \pmod{p_1},$$

$$C_2 \equiv M_2^{d_2} \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv M_k^{d_k} \pmod{p_k},$$

wherein

$$M_1 \equiv M \pmod{p_1},$$

$$M_2 \equiv M \pmod{p_2},$$

$$\vdots$$

$$M_k \equiv M \pmod{p_k},$$

$$d_1 \equiv d \pmod{(p_1 - 1)},$$

$$d_2 \equiv d \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$d_k \equiv d \pmod{(p_k - 1)},$$

where  $d$  is defined by

$$d \equiv e^{-1} \pmod{(p_1 - 1) \cdot (p_2 - 1) \cdot \dots \cdot (p_k - 1)}, \text{ and}$$

e is a number relatively prime to  $(p_1-1)$ ,  $(p_2-1)$ , ..., and  $(p_k-1)$ , solving said sub-tasks to determine results  $C_1, C_2, \dots C_k$ , and  
combining said results of said sub-tasks to produce said ciphertext word C.

53. (Original) A digital signature generation system as recited in claim 52 wherein said signature generating means is operative to combine said results of said sub-tasks by performing a recursive combining process to produce said signed ciphertext word C.

54. (Original) A digital signature generation system as recited in claim 53 wherein said digital signature generating means is operative to perform said recursive combining process in accordance with

$$Y_i \equiv Y_{i-1} + \left[ (M_i - Y_{i-1})(w_i^{-1} \bmod p_i) \bmod p_i \right] \bullet w_i \bmod n,$$

wherein  $2 \leq i \leq k$ , and

$$C = Y_k, Y_1 = C_1, \text{ and } w_i = \prod_{j < i} p_j.$$

55. (Original) A digital signature generation system as recited in claim 52 wherein said signature generating means is operative to combine said results of said sub-tasks by performing a summation process to produce said signed message word C.

56. (Original) A digital signature system as recited in claim 55 wherein said signature generating means  
is operative to perform said summation process in accordance with

$$C \equiv \sum_{i=1}^k C_i (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

57. (Previously Presented) A digital signature process, comprising the steps of:  
signing a plaintext message word M to create a signed ciphertext word C, wherein M corresponds to a number representative of a message and wherein  
 $0 \leq M \leq n-1$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers,  $C$  is a number representative of a signed form of message word  $M$ , and wherein said encoding step comprises transforming said message word  $M$  to said ciphertext word  $C$  whereby,

$$C = M^d \pmod{n},$$

wherein  $d$  is defined by

$$d \equiv e^{-1} \pmod{((p_1 - 1) \cdot (p_2 - 1) \cdot \dots \cdot (p_k - 1))}, \text{ and}$$

$e$  is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ ; and

verifying said ciphertext word  $C$  to a receive message word  $M'$  by performing the steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{e_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{e_2} \pmod{p_2},$$

$$\vdots$$

$$M_k' \equiv C_k^{e_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv C \pmod{p_k},$$

$$e_1 \equiv e \pmod{(p_1 - 1)},$$

$$e_2 \equiv e \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$e_k \equiv e \pmod{(p_k - 1)},$$

solving said sub-tasks to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .



58. (Original) A digital signature process as recited in claim 57 wherein said step of combining said results of said sub-tasks includes a step of performing a recursive combining process to produce said receive message word  $M'$ .

59. (Original) A digital signature process as recited in claim 58 wherein said recursive combining process is performed in accordance with

$$Y_i \equiv Y_{i-1} + \left[ (M_i' - Y_{i-1})(w_i^{-1} \bmod p_i) \bmod p_i \right] \bullet w_i \bmod n,$$

wherein  $2 \leq i \leq k$ , and

$$M' = Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.$$

60. (Original) A digital signature process as recited in claim 58 wherein said step of combining said results of said sub-tasks includes a step of performing a summation process to produce said receive message word  $M'$ .

61. (Original) A digital signature process as recited in claim 60 wherein said summation process is performed in accordance with

$$M' \equiv \sum_{i=1}^k M_i' (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

62. (Previously Presented) A digital signature system, comprising:  
a communication medium;

digital signature generating means coupled to said communication medium and adapted for transforming a message word  $M$  to a signed ciphertext word  $C$  and for transmitting said signed ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$0 \leq M \leq n-1$ , wherein  $n$  is a composite number of the form

$$n = p_1 \bullet p_2 \bullet \dots \bullet p_k,$$

wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said signed ciphertext word  $C$  corresponds to a number representative of a signed form of said message word  $M$  and corresponds to

$$C \equiv M^d \pmod{n},$$

wherein  $d$  is defined by

$$d \equiv e^{-1} \pmod{(p_1 - 1) \cdot (p_2 - 1) \cdot \dots \cdot (p_k - 1)}, \text{ and}$$

$e$  is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ ; and

digital signature verification means communicatively coupled with said communication medium for receiving said signed ciphertext word  $C$  via said medium, and being operative to verify said signed ciphertext word  $C$  by performing the steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{e_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{e_2} \pmod{p_2},$$

$$\vdots$$

$$M_k' \equiv C_k^{e_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv C \pmod{p_k},$$

$$e_1 \equiv e \pmod{(p_1 - 1)},$$

$$e_2 \equiv e \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$e_k \equiv e \pmod{(p_k - 1)},$$

solving said sub-tasks to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

63. (Original) A digital signature system as recited in claim 62 wherein said decoding means is operative to combine said results of said sub-tasks by performing a recursive combining process to produce said receive message word  $M'$ .

64. (Original) A digital signature system as recited in claim 63 wherein said decoding means is operative to perform said recursive combining process in accordance with

$$Y_i \equiv Y_{i-1} + [(M_i' - Y_{i-1})(w_i^{-1} \bmod p_i) \bmod p_i] \bullet w_i \bmod n,$$

wherein  $2 \leq i \leq k$ , and

$$M' = Y_k, Y_1 = M_1', \text{ and } w_i = \prod_{j < i} p_j.$$

65. (Original) A digital signature system as recited in claim 62 wherein said decoding means is operative combine said results of said sub-tasks by performing a summation process to produce said receive message word  $M'$ .

66. (Original) A digital signature system as recited in claim 65 wherein said decoding means is operative to perform said summation process accordance with

$$M' \equiv \sum_{i=1}^k M_i' (w_i^{-1} \bmod p_i) w_i \bmod n,$$

where

$$w_i = \prod_{j \neq i} p_j.$$

67-72 (Cancelled)

73. (Original) A method as recited in claim 17 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

74. (Original) A method as recited in claim 17 wherein each of said distinct random prime number has the same number of bits.

75. (Original) A cryptographic communications system as recited in claim 22 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

76. (Original) A cryptographic communications system as recited in claim 22 wherein each of said distinct random prime number has the same number of bits.

77. (Original) A method as recited in claim 27 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

78. (Original) A method as recited in claim 27 wherein each of said distinct random prime number has the same number of bits.

79. (Original) A cryptographic communications system as recited in claim 32 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

80. (Original) A cryptographic communications system as recited in claim 32 wherein each of said distinct random prime number has the same number of bits.

81. (Original) A method as recited in claim 37 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

82. (Original) A method as recited in claim 37 wherein each of said distinct random prime number has the same number of bits.

83. (Original) A cryptographic communications system as recited in claim 42 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

84. (Original) A cryptographic communications system as recited in claim 42 wherein each of said distinct random prime number has the same number of bits.

85. (Original) A method as recited in claim 47 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

86. (Original) A method as recited in claim 47 wherein each of said distinct random prime number has the same number of bits.

87. (Original) A digital signature generation system as recited in claim 52 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

88. (Original) A digital signature generation system as recited in claim 52 wherein each of said distinct random prime number has the same number of bits.

89. (Original) A digital signature process as recited in claim 57 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

90. (Original) A digital signature process as recited in claim 57 wherein each of said distinct random prime number has the same number of bits.

91. (Original) A digital signature system as recited in claim 62 wherein said step of solving said sub-tasks includes processing each of said sub-tasks by an associated one of a plurality of exponentiator units operating substantially simultaneously.

92. (Original) A digital signature system as recited in claim 62 wherein each of said distinct random prime number has the same number of bits.

93. (Previously Presented) A method as recited in claim 17 wherein the plurality of  $k$  sub-tasks are performed in parallel.
94. (Previously Presented) A method as recited in claim 93 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).
95. (Previously Presented) A cryptographic communications system as recited in claim 22 wherein the plurality of  $k$  sub-tasks are performed in parallel.
96. (Previously Presented) A cryptographic communications system as recited in claim 95 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).
97. (Previously Presented) A method as recited in claim 27 wherein the plurality of  $k$  sub-tasks are performed in parallel.
98. (Previously Presented) A method as recited in claim 97 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).
99. (Previously Presented) A cryptographic communications system as recited in claim 32 wherein the plurality of  $k$  sub-tasks are performed in parallel.
100. (Previously Presented) A cryptographic communications system as recited in claim 99 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).
101. (Previously Presented) A method as recited in claim 37 wherein the plurality of  $k$  sub-tasks are performed in parallel.
102. (Previously Presented) A method as recited in claim 101 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).
103. (Previously Presented) A cryptographic communications system as recited in claim 42 wherein the plurality of  $k$  sub-tasks are performed in parallel.

104. (Previously Presented) A cryptographic communications system as recited in claim 103 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).

105. (Previously Presented) A method as recited in claim 47 wherein the plurality of k sub-tasks are performed in parallel.

106. (Previously Presented) A method as recited in claim 105 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).

107. (Previously Presented) A digital signature generation system as recited in claim 52 wherein the plurality of k sub-tasks are performed in parallel.

108. (Previously Presented) A digital signature generation system as recited in claim 107 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).

109. (Previously Presented) A digital signature process as recited in claim 57 wherein the plurality of k sub-tasks are performed in parallel.

110. (Previously Presented) A digital signature process as recited in claim 109 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).

111. (Previously Presented) A digital signature system as recited in claim 62 wherein the plurality of k sub-tasks are performed in parallel.

112. (Previously Presented) A digital signature system as recited in claim 111 wherein said step of combining uses a form of the Chinese Remainder Theorem (CRT).

113. (Currently Amended) A method for establishing cryptographic communications, comprising the steps of:

encoding a plaintext message word M to a ciphertext word C, wherein M corresponds to a number representative of a message and wherein

$$0 \leq M \leq n-1,$$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers,  $C$  is a number representative of an encoded form of message word  $M$ , and wherein said encoding step comprises transforming said message word  $M$  to said ciphertext word  $C$ , whereby

$$C \equiv M^e \pmod{n},$$

and wherein  $e$  is a number relatively prime to  $(p_1-1)$ ,  $(p_2-1)$ , ..., and  $(p_k-1)$ ; and

decoding said ciphertext word  $C$  to a receive message word  $M'$ , said decoding step being performed using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \pmod{((p_1 - 1) (p_2 - 1) \dots (p_k - 1))},$$

said decoding step including the further steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{d_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{d_2} \pmod{p_2},$$

$$\vdots$$

$$M_k' \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv C \pmod{p_k},$$

$$d_1 \equiv d \pmod{(p_1 - 1)},$$

$$d_2 \equiv d \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$d_k \equiv d \pmod{(p_k - 1)},$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .



114. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

encoding means coupled to said communication medium and adapted for transforming a transmit message word  $M$  to a ciphertext word  $C$  and for transmitting said ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$0 \leq M \leq n-1$ , wherein  $n$  is a composite number of the form,

$$n = p_1 \cdot p_2 \cdot \dots \cdot p_k$$

wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said ciphertext word  $C$  corresponds to a number representative of an enciphered form of said message word  $M$  and corresponds to

$$C \equiv M^e \pmod{n},$$

wherein  $e$  is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ; and

decoding means communicatively coupled with said communication medium for receiving said ciphertext word  $C$  via said medium, said decoding means being operative to perform a decryption process for transforming said ciphertext word  $C$  to a receive message word  $M'$ , wherein  $M'$  corresponds to a number representative of a deciphered form of  $C$ , said decryption process using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \pmod{(p_1-1)(p_2-1)\dots(p_k-1)},$$

said decryption process including the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{d_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{d_2} \pmod{p_2},$$

$\vdots$

$$M_k' \equiv C_k^{d_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$\vdots$

$$C_k \equiv C \pmod{p_k},$$

$$\begin{aligned}d_1 &\equiv d(\text{mod}(p_1 - 1)), \\d_2 &\equiv d(\text{mod}(p_2 - 1)), \text{ and} \\&\vdots \\d_k &\equiv d(\text{mod}(p_k - 1)),\end{aligned}$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

115. (Previously Presented) A method for establishing cryptographic communications, comprising the step of:

encoding a plaintext message word  $M$  to a ciphertext word  $C$ , wherein  $M$  corresponds to a number representative of a message, and

$$0 \leq M \leq n - 1$$

$n$  being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein the ciphertext word  $C$  is a number representative of an encoded form of message word  $M$ , wherein said step of encoding includes the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$\begin{aligned}C_1 &\equiv M_1^{e_1}(\text{mod } p_1), \\C_2 &\equiv M_2^{e_2}(\text{mod } p_2), \\&\vdots \\C_k &\equiv M_k^{e_k}(\text{mod } p_k),\end{aligned}$$

wherein

$$\begin{aligned}M_1 &\equiv M(\text{mod } p_1), \\M_2 &\equiv M(\text{mod } p_2), \\&\vdots \\M_k &\equiv M(\text{mod } p_k),\end{aligned}$$

$$\begin{aligned} e_1 &\equiv e(\text{mod}(p_1 - 1)), \\ e_2 &\equiv e(\text{mod}(p_2 - 1)), \text{ and} \\ &\vdots \\ e_k &\equiv e(\text{mod}(p_k - 1)), \end{aligned}$$

wherein  $e$  is a number relatively prime to  $(p_1-1)$ ,  $(p_2-1)$ , ..., and  $(p_k-1)$ , solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $C_1, C_2, \dots C_k$ , and combining said results of said sub-tasks to produce said ciphertext word  $C$ .

116. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

encoding means coupled to said communication medium and operative to transform a transmit message word  $M$  to a ciphertext word  $C$ , and to transmit said ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$$0 \leq M \leq n-1,$$

$n$  being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$  wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$ , are distinct random prime numbers, and wherein the ciphertext word  $C$  is a number representative of an encoded form of message word  $M$ , said encoding means being operative to transform said transmit message word  $M$  to said ciphertext word  $C$  by performing an encoding process comprising the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$\begin{aligned} C_1 &\equiv M_1^{e_1} (\text{mod } p_1), \\ C_2 &\equiv M_2^{e_2} (\text{mod } p_2), \\ &\vdots \\ C_k &\equiv M_k^{e_k} (\text{mod } p_k), \end{aligned}$$

wherein

$$\begin{aligned} M_1 &\equiv M (\text{mod } p_1), \\ M_2 &\equiv M (\text{mod } p_2), \end{aligned}$$

$$\begin{aligned}
& \vdots \\
M_k & \equiv M \pmod{p_k}, \\
e_1 & \equiv e \pmod{(p_1 - 1)}, \\
e_2 & \equiv e \pmod{(p_2 - 1)}, \text{ and} \\
& \vdots \\
e_k & \equiv e \pmod{(p_k - 1)},
\end{aligned}$$

wherein  $e$  is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ , solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $C_1, C_2, \dots, C_k$ , and combining said results of said sub-tasks to produce said ciphertext word  $C$ .

117. (Previously Presented) A method for establishing cryptographic communications, comprising the steps of:

decoding a ciphertext word  $C$  to a message word  $M$ , wherein  $M$  corresponds to a number representative of a message and wherein

$$0 \leq M \leq n - 1$$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers,  $C$  is a number representative of an encoded form of message word  $M$  that is encoded by transforming said message word  $M$  to said ciphertext word  $C$  whereby

$$C \equiv M^e \pmod{n},$$

and wherein  $e$  is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ ;

said decoding step being performed using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \pmod{((p_1 - 1)(p_2 - 1) \dots (p_k - 1))},$$

wherein said step of decoding includes the steps of

defining a plurality of  $k$  sub-tasks in accordance with

$$\begin{aligned}
M_1 & \equiv C_1^{d_1} \pmod{p_1}, \\
M_2 & \equiv C_2^{d_2} \pmod{p_2}, \\
& \vdots \\
M_k & \equiv C_k^{d_k} \pmod{p_k},
\end{aligned}$$

wherein

$$C_1 \equiv C(\text{mod } p_1),$$

$$C_2 \equiv C(\text{mod } p_2),$$

$\vdots$

$$C_k \equiv C(\text{mod } p_k),$$

$$d_1 \equiv d(\text{mod}(p_1 - 1)),$$

$$d_2 \equiv d(\text{mod}(p_2 - 1)), \text{ and}$$

$\vdots$

$$d_k \equiv d(\text{mod}(p_k - 1)),$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $M_1, M_2, \dots, M_k$ , and

combining said results of said sub-tasks to produce said message word  $M$ .

118. (Previously Presented) A cryptographic communications system for establishing communications, comprising:

a communication medium;

decoding means communicatively coupled with said communication medium for receiving a ciphertext word  $C$  via said medium, and being operative to transform said ciphertext word  $C$  to a receive message word  $M'$ , wherein a message  $M$  corresponds to a number representative of a message and wherein,

$$0 \leq M \leq n - 1$$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said ciphertext word  $C$  is a number representative of an encoded form of said message word  $M$  that is encoded by transforming  $M$  to said ciphertext word  $C$  whereby,

$$C \equiv M^e (\text{mod } n),$$

and wherein  $e$  is a number relatively prime to  $(p_1 - 1), (p_2 - 1), \dots$ , and  $(p_k - 1)$ ;

said decoding means being operative to perform a decryption process using a decryption exponent  $d$  that is defined by

$$d \equiv e^{-1} \text{mod}((p_1 - 1)(p_2 - 1) \dots (p_k - 1)),$$

said decryption process including the steps of  
defining a plurality of k sub-tasks in accordance with,

$$\begin{aligned} M_1' &\equiv C_1^{d_1} \pmod{p_1}, \\ M_2' &\equiv C_2^{d_2} \pmod{p_2}, \\ &\vdots \\ M_k' &\equiv C_k^{d_k} \pmod{p_k}, \end{aligned}$$

wherein

$$\begin{aligned} C_1 &\equiv C \pmod{p_1}, \\ C_2 &\equiv C \pmod{p_2}, \\ &\vdots \\ C_k &\equiv C \pmod{p_k}, \end{aligned}$$

$$\begin{aligned} d_1 &\equiv d \pmod{(p_1 - 1)}, \\ d_2 &\equiv d \pmod{(p_2 - 1)}, \text{ and} \\ &\vdots \\ d_k &\equiv d \pmod{(p_k - 1)}, \end{aligned}$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

119. (Previously Presented) A method for generating a digital signature, comprising the step of:

signing a plaintext message word M to create a signed ciphertext word C, wherein M corresponds to a number representative of a message, and

$$0 \leq M \leq n-1,$$

n being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , wherein k is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein the signed ciphertext word C is a number representative of a signed form of message word M, wherein

$$C \equiv M^d \pmod{n}, \text{ and}$$

wherein said step of signing includes the steps of  
defining a plurality of k sub-tasks in accordance with

$$\begin{aligned} C_1 &\equiv M_1^{d_1} \pmod{p_1}, \\ C_2 &\equiv M_2^{d_2} \pmod{p_2}, \\ &\vdots \\ C_k &\equiv M_k^{d_k} \pmod{p_k}, \end{aligned}$$

wherein

$$\begin{aligned} M_1 &\equiv M \pmod{p_1}, \\ M_2 &\equiv M \pmod{p_2}, \\ &\vdots \\ M_k &\equiv M \pmod{p_k}, \end{aligned}$$

$$\begin{aligned} d_1 &\equiv d \pmod{(p_1 - 1)}, \\ d_2 &\equiv d \pmod{(p_2 - 1)}, \text{ and} \\ &\vdots \\ d_k &\equiv d \pmod{(p_k - 1)}, \end{aligned}$$

where d is defined by

$$d \equiv e^{-1} \pmod{((p_1 - 1) \cdot (p_2 - 1) \cdot \dots \cdot (p_k - 1))}, \text{ and}$$

e is a number relatively prime to  $(p_1 - 1)$ ,  $(p_2 - 1)$ , ..., and  $(p_k - 1)$ , solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $C_1$ ,  $C_2$ , ...  $C_k$ , and

combining said results of said sub-tasks to produce said ciphertext word C.

120. (Previously Presented) A digital signature generation system, comprising:

a communication medium;

digital signature generating means coupled to said communication medium and operative to transform a transmit message word M to a signed ciphertext word C, and to transmit said signed ciphertext word C on said medium, wherein M corresponds to a number representative of a message, and

$$0 \leq M \leq n - 1,$$

n being a composite number formed from the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ , k wherein k is an integer greater than 2 and  $p_1, p_2, \dots, p_k$ , are distinct random prime numbers, and wherein the signed ciphertext word C is a number representative of a signed form of said message word M, wherein

$$C \equiv M^d \pmod{n},$$

said digital signature generating means being operative to transform said transmit message word M to said signed ciphertext word C by performing a digital signature generating process comprising the steps of,

defining a plurality of k sub-tasks in accordance with,

$$C_1 \equiv M_1^{d_1} \pmod{p_1},$$

$$C_2 \equiv M_2^{d_2} \pmod{p_2},$$

$$\vdots$$

$$C_k \equiv M_k^{d_k} \pmod{p_k},$$

wherein

$$M_1 \equiv M \pmod{p_1},$$

$$M_2 \equiv M \pmod{p_2},$$

$$\vdots$$

$$M_k \equiv M \pmod{p_k},$$

$$d_1 \equiv d \pmod{(p_1 - 1)},$$

$$d_2 \equiv d \pmod{(p_2 - 1)}, \text{ and}$$

$$\vdots$$

$$d_k \equiv d \pmod{(p_k - 1)},$$

where d is defined by

$$d \equiv e^{-1} \pmod{(p_1 - 1) \cdot (p_2 - 1) \cdot \dots \cdot (p_k - 1)}, \text{ and}$$

e is a number relatively prime to  $(p_1 - 1), (p_2 - 1), \dots$ , and  $(p_k - 1)$ , solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $C_1, C_2, \dots, C_k$ , and

combining said results of said sub-tasks to produce said ciphertext word C.

121. (Previously Presented) A digital signature process, comprising the steps of:



signing a plaintext message word  $M$  to create a signed ciphertext word  $C$ , wherein  $M$  corresponds to a number representative of a message and wherein

$$0 \leq M \leq n-1$$

wherein  $n$  is a composite number formed by the product of  $p_1 \cdot p_2 \cdot \dots \cdot p_k$ ,  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers,  $C$  is a number representative of a signed form of message word  $M$ , and wherein said encoding step comprises transforming said message word  $M$  to said ciphertext word  $C$  whereby,

$$C = M^d \pmod{n},$$

wherein  $d$  is defined by

$$d \equiv e^{-1} \pmod{(p_1-1) \cdot (p_2-1) \cdot \dots \cdot (p_k-1)}, \text{ and}$$

$e$  is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ; and

verifying said ciphertext word  $C$  to a receive message word  $M'$  by performing the steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{e_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{e_2} \pmod{p_2},$$

$\vdots$

$$M_k' \equiv C_k^{e_k} \pmod{p_k},$$

wherein

$$C_1 \equiv C \pmod{p_1},$$

$$C_2 \equiv C \pmod{p_2},$$

$\vdots$

$$C_k \equiv C \pmod{p_k},$$

$$e_1 \equiv e \pmod{(p_1-1)},$$

$$e_2 \equiv e \pmod{(p_2-1)}, \text{ and}$$

$\vdots$

$$e_k \equiv e \pmod{(p_k-1)},$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem wherein each sub-task is a Chinese Remainder Theorem sub-problem to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .

122. (Previously Presented) A digital signature system, comprising:

a communication medium;

digital signature generating means coupled to said communication medium and adapted for transforming a message word  $M$  to a signed ciphertext word  $C$  and for transmitting said signed ciphertext word  $C$  on said medium, wherein  $M$  corresponds to a number representative of a message, and

$0 \leq M \leq n-1$ , wherein  $n$  is a composite number of the form

$$n = p_1 \cdot p_2 \cdot \dots \cdot p_k,$$

wherein  $k$  is an integer greater than 2 and  $p_1, p_2, \dots, p_k$  are distinct random prime numbers, and wherein said signed ciphertext word  $C$  corresponds to a number representative of a signed form of said message word  $M$  and corresponds to

$$C \equiv M^d \pmod{n},$$

wherein  $d$  is defined by

$$d \equiv e^{-1} \pmod{(p_1-1) \cdot (p_2-1) \cdot \dots \cdot (p_k-1)}, \text{ and}$$

$e$  is a number relatively prime to  $(p_1-1), (p_2-1), \dots$ , and  $(p_k-1)$ ; and

digital signature verification means communicatively coupled with said communication medium for receiving said signed ciphertext word  $C$  via said medium, and being operative to verify said signed ciphertext word  $C$  by performing the steps of,

defining a plurality of  $k$  sub-tasks in accordance with

$$M_1' \equiv C_1^{e_1} \pmod{p_1},$$

$$M_2' \equiv C_2^{e_2} \pmod{p_2},$$

$\vdots$

$$M_k' \equiv C_k^{e_k} \pmod{p_k},$$

wherein

$$C_i \equiv C \pmod{p_i},$$

$$C_2 \equiv C(\text{mod } p_2),$$

$\vdots$

$$C_k \equiv C(\text{mod } p_k),$$

$$e_1 \equiv e(\text{mod}(p_1 - 1)),$$

$$e_2 \equiv e(\text{mod}(p_2 - 1)), \text{ and}$$

$\vdots$

$$e_k \equiv e(\text{mod}(p_k - 1)),$$

solving said sub-tasks in parallel using a form of the Chinese Remainder Theorem to determine results  $M_1', M_2', \dots, M_k'$ , and

combining said results of said sub-tasks to produce said receive message word  $M'$ , wherein  $M' = M$ .